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SOME IMPLICATIONS OF MODERN TRAINING TECHNOLOGY FOR EDUCATION.(U)
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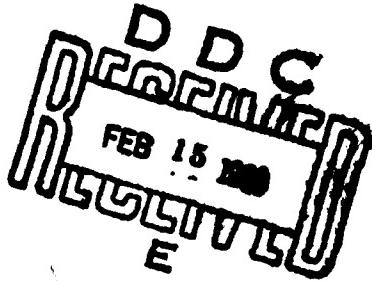
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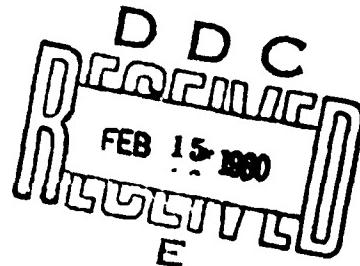
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10 by
Robert G. Smith, Jr.

15 DHHC 19-70-C-0012,2
DH-44-188-AK0-2

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Some Implications of Modern Training Technology for Education

Robert G. Smith, Jr.

Over the past 15 years a body of concepts and techniques for effective training has emerged, primarily through the efforts of military training researchers with contributions from the field of programmed instruction.

The purpose of this paper is to outline the principal concepts of training and their implications for education. Training refers to the arrangement of situations so that the student learns performances required in specific, definable situations, usually a job. Education, on the other hand, deals with preparing the individual for a wide variety of future situations, including life outside the confines of the job situation.

MODERN TRAINING CONCEPTS

The Priority of the Objective

Modern concepts of training emphasize the importance of starting the planning of training programs with a clear specification of the objective, derived from the job the student is to perform after training (Smith, 1964).

A clear specification of the objective is considered to be a statement that describes the following elements (Mager):

1. The particular performance or behavior -- described in action words -- the student is expected to display after training.
2. The conditions under which the performance is to be observed.
3. The standard of accuracy, correctness, or speed to be attained by the student.

The derivation of the objectives is performed in accordance with the following steps (Smith, 1964):

1. The system in which the job occurs is analyzed to provide an appropriate understanding of the context surrounding the job.

2. A tentative inventory of the duties and tasks which the job requires is developed.

3. The tentative inventory is checked for completeness by having a sample of job incumbents review it.

4. The inventory is used as a basis of a questionnaire to develop data with which to determine priorities for training. Such information as the following is developed about each task:

- a. Number of people performing it.
- b. Importance to mission success.
- c. Ease of training on the job.
- d. How soon after assignment the task must be performed.

5. Based on this information, a decision is made as to whether a task is to be taught at all, and if so, to what standard of proficiency.

6. For those tasks to be taught, a detailed analysis of all the cues and responses involved is conducted.

7. Appropriate knowledges and skills (enabling objectives) are identified.

8. These are synthesized into a hierarchy, or outline, of objectives, each of which states behavior, conditions, and standards.

Ammerman and Melching (1966) distinguish three levels of objectives. First is the general goal or purpose of a course. Next is the terminal objective, which describes a meaningful unit of real life (or job) activity. At the third and lowest level are enabling objectives, which describe knowledges and skills that must be mastered in order to accomplish the terminal objective; this distinction is important because the enabling objective is vital to our later consideration of education.

The list of terminal objectives provides the necessary guidance so that all the many elements of a training program may be kept in line -- working toward accomplishing the objectives. Texts, lectures, films, demonstrations, tests, training aids, and devices can all be made consistent in their operation. Student motivation can be improved by letting students know what is required of them.

Quality Control in Training

A quality control system is a vital component of an effective training program. Tests designed to reflect the objectives as accurately

as possible are administered to the students. The results of the tests are provided to those directly responsible for instruction, making possible a continuous program of improvement. The tests can be analyzed to pinpoint the exact nature of any failures to teach, even to the individual instructor responsible (Smith, 1965).

An important aspect of the tests is that they are scored on an absolute, pass-fail basis. Each objective carries a certain standard with it. The student either meets the standard or he does not. The student generally passes if he succeeds on a reasonable percentage of the tests. On the other hand, it may be appropriate to fail the student in the course if he does not pass certain tests involving critically important objectives.

Many current grading practices are based on the idea of ranking students. These practices are inappropriate. Specifically, these methods include:

1. Grading on the basis of the normal curve.
2. Use of percentile ranks.
3. Eliminating tests and items which nearly everyone either passes or fails.
4. Correlating answers to test items with the total score on the test.

The procedures listed above are more appropriate for selecting students than they are for determining whether students attain objectives.

The Instructional System

An instructional system is an integrated set of media, equipment, methods, and personnel performing efficiently the functions required to accomplish one or more objectives (Smith, in press).

This concept of an instructional system implies the following:

1. Objectives have been established, and the purpose of the system is to accomplish these objectives.
2. Several functions must be performed to attain the objectives.
3. There are usually many ways to assemble the components required to reach a given objective. It is necessary to measure both the effectiveness of the components and the cost of attaining a given level of effectiveness.

The following functions of an instructional system have been identified:

1. Development of objectives.
2. Practice of performance.
3. Practice of knowledge.
4. Presentation of knowledge.
5. Student management.
6. Quality control.

Objectives and quality control have already been discussed. The remainder of this section will describe briefly the remaining functions.

Practice of Performance. Practice of performance is concerned with the practice of terminal objectives and those enabling objectives that are skills. The following are the critical considerations:

1. The design of a practice situation that simulates the situation in which the performance would normally be carried out. This means provision of cues for student action, and opportunity for student practice of appropriate responses.
2. The student is provided with knowledge of results as to the correctness of his responses.
3. A suitable practice schedule with a short rest between repetitions, or trials, of practice is provided.

Practice of Knowledge. The practice of knowledge refers to the practice of those enabling objectives that refer to the use of symbols -- words, pictures, codes, for example. The critical matters here are:

1. A method for presenting a symbolic cue to the student.
2. A method for judging whether the student's response is correct.
3. A method for delivering knowledge of results to the student.
4. The requirement for the student to reach a high level of mastery to ensure transfer to the terminal objective.

Presentation of Knowledge. The presentation of knowledge is a one-way communication to the student. As long as the communication

can be accurately received, is meaningful, and is properly spaced, there is little difference between types of media in terms of effectiveness. Thus -- within these constraints -- books, films, slides, television, or human teachers are equally effective for this function.

Student Management. This function is concerned with the matters necessary to keep the student profitably occupied in learning activities.

Individual differences in aptitude and experience will mean that students will learn at different rates, and that they will not all be able to perceive meaningfulness in the same material. The instructional system should capitalize on these individual differences as an essential element.

Reinforcement for the completion of learning activity, according to an appropriate schedule, can aid maintenance of effective student activity. It is especially important to avoid rewarding failure or punishing success.

Appropriate sequencing of instruction can make reaching objectives easier for the student. The preferred sequence is giving an overview of the material first, then teaching the terminal objectives. The related enabling objectives are taught in conjunction with each terminal objective. Placing common enabling objectives in a block of "basic" or "fundamental" content can make the objectives less meaningful and more difficult to learn.

Automation

When the various functions of an instructional system are examined, it is clear that many of them can be carried out by means other than human activity. Automation is a non-human way of carrying out a function of the system. Simulators may be used for practice of performance. Practice of knowledge may be carried out using programmed texts, computers, workbooks, flash cards, etc. Naturally, presentation of knowledge may be handled with television, films, slides, or tape recorders.

Whether a function is carried out by a human or an automated form of instruction should be determined by a cost and effectiveness evaluation.

Cost-Effectiveness

A course is effective to the extent its objectives are reached by its students. An indication of the effectiveness of the system can be provided by employing the quality control function. The costs of a given system can also be measured to provide a basis for comparing different system designs in terms of their cost-effectiveness ratios.

IMPLICATIONS FOR EDUCATION

The major concepts of the training technology -- the objective, quality control, the instructional system, automation, and cost-effectiveness -- have been considered. We will now turn to a discussion of the implications of these concepts for education.

The Objective

Training objectives are derived from an analysis of a specific work situation. On the other hand, educational objectives are concerned with fitting an individual for a wide variety of situations, both work and leisure.

These objectives must be derived from the analysis of the terminal objectives representing meaningful units of life activity. In the derivation of educational objectives, there must be developed a catalog of meaningful units of life activity appropriate for each level of the individual's development. From these the appropriate enabling objectives should be derived.

Whereas the principal focus of training is on the specific terminal objective, representing meaningful units of work activity, the principal focus of education should be on the enabling objectives that contribute to the greatest number of terminal objectives.

There is, therefore, a requirement for continual description and analysis to identify the terminal objectives and to derive enabling objectives from them. In order to reduce obsolescence, the terminal objectives should include reasonable projections into the future, and where appropriate, include terminal objectives from various career stages.

This task will be easier the closer the educational situation approaches the training situation. Thus it will be relatively easy to derive objectives for college-level courses in forestry, business, law, medicine, and engineering, and much more difficult for the liberal arts college and public education.

As a more detailed example, let us consider electrical engineering. The following would seem to be a reasonable approach:

1. Develop a task inventory that identifies the range of tasks engaged in by electrical engineers (EE's) throughout their careers.
2. Administer this as a questionnaire to a sample of EE's, using the hierarchical grouping techniques developed by the Air Force (Morsch, Madden and Christal) to identify job clusters and to develop composite descriptions for different stages in the individual's career.

3. Develop a set of enabling objectives for each task performed by a significant portion of the EE work force.

4. Select enabling objectives contributing to the widest number of tasks.

5. Going through steps 1 and 2 every few years will identify trends from which extrapolations into the future can be made. Whenever significant changes occur, then analyses of the enabling objectives can identify the need to change the curriculum.

The college of arts and sciences has a different problem. There are usually two general objectives. One is to prepare scientists and scholars for graduate study. The other is to provide a more effective basis for participation in non-job life situations.

Graduate study to develop scholars and scientists is professional education no different from that of the EE. Comparable considerations apply, and a rigorous analysis will lay out the objectives in a sequence extending from the Ph.D. to the college freshman level.

For the liberal arts program for students who do not plan to be a scholar, the objectives are derived from the individual's interaction with his culture, again, with reasonable projections into the future.

Similar considerations apply to the public schools. A catalog of real-life performances needs to be made in order to derive the appropriate enabling objectives.

An approach to this problem could be taken as follows:

1. Prepare a description of the salient aspects of American and world social-physical environment, both present and projected into the future.

2. Identify a set of "tasks" representing a set of performances required to deal effectively with that environment.

3. Apply the clustering procedures to observations of frequency and extent of these performances.

4. Identify enabling objectives.

Objectives should be specified in terms of behavior, conditions, and standards. Words such as understand, appreciate, and know would be suitable only for general objectives.

Quality Control

Lack of a quality control system is a major shortcoming of education today. Practically no one knows who is a good teacher and who

is a poor one. The result is that there can be no economic recognition for competence as a teacher. In the public schools teachers receive compensation for degrees and seniority. In the universities personnel are rewarded for research or scholarship as measured by publications.

No one can tell a school which is effective from one which is not, or a college where one learns from one that has prestige. There is a major requirement for a quality control system that publicly indicates which teacher and which schools or colleges are accomplishing their objectives. Perhaps when teaching is measured it will be possible to raise salaries for those teachers who have shown they can consistently teach well.

In many colleges there is an attempt, through the use of grading on the curve, to select rather than teach. Thus, the prestigious colleges can select the upper one or two percent of high school graduates, and then fail a percentage of these through grading practices more suitable for ranking students than determining whether they have reached the objective. This is a very wasteful treatment of scarce brainpower.

The Systems Concept

One of the more important aspects of the systems concept is that of critically examining all the functions required to ensure learning. Modern innovations may well fail because their function has not been integrated with all other functions.

For example, the author's daughter, in three years of elementary school, has learned to hate French. It was done as follows: Three times a week the teacher quieted the class and turned on the television set. One half hour later she turned it off, and that was all she did. The program was entirely in French. French then became something the students didn't understand, but for which they had to stay quiet. The system concept suggests there was a need to assure communication, and to provide practice. Both of these were lacking. In defense of the teachers, they knew no French and felt quite inadequate in the situation. The systems approach suggests a traveling French teacher or training for the regular teacher.

Practice of Performance. Where the enabling objectives represent skills, and in appropriate terminal objectives, there is seldom consideration of the requirement for rapid provision of knowledge of results to the student. Similarly, the possibility of maximizing the opportunities for practice often is missing.

Practice of Knowledge. Since education should focus on the enabling objectives, and these will be predominantly knowledge, there is an urgent requirement for techniques designed to be effective and efficient. Again, opportunity should be provided for maximum participation in practice, with rapid delivery of knowledge of results.

Presentation of Knowledge. The more common forms of presentation are seldom tested to be sure they communicate to the intended receiver. There is a real need to check on the communicability of those items which represent a major economic outlay, such as texts, films, and television programs.

With regard to films and television, it is well established that many dramatic techniques do not contribute to learning and therefore can be eliminated without loss.

Student Management. Perhaps the greatest violation of the system concept is in the system of yearly grade levels that goes strongly against the facts of individual differences. The following points appear relevant:

1. The fact that repetition aids learning is well known, but if the student does not learn in the allotted time, he must generally wait a full year to repeat.

2. Students who can learn rapidly soon learn there is little point in doing so.

3. Objectives should be organized into small, coherent groups, arranged so students can master them as fast as they are able.

4. Compulsory education laws, combined with social and other pressures, led to the establishment of 12-year public school programs, even for students who have the capability to complete the program one or more years earlier. Even the few ungraded high schools add "enrichment" courses to keep students in school for 12 years. Incidentally, the compulsory education laws are a very interesting form of involuntary servitude. In a society that bans involuntary servitude (in the form of slavery or peonage) or establishes strict safeguards before it is imposed (in the case of imprisonment), we seldom object to the enormous restriction of an individual's freedom required by the grade system.

5. Automated methods of instruction make it quite feasible to let students learn as fast as they are able, while grouping them by age where this seems desirable for socializing activity.

6. The costs of facilities, teachers, and supplies created by the grade system are probably measured in the billions.

Reinforcement, for the purpose of keeping the student actively pursuing the learning process, is rarely applied.

It will be remembered that the preferred sequence of training objectives is one in which the enabling objectives are taught in the context of appropriate terminal objectives. If education emphasizes enabling objectives, how can they be made meaningful?

In order to apply the functional context principle in this case, we must relate the enabling objective to terminal objectives which are meaningful for the student. Thus, even though different schools in an area may have the same enabling objectives, the terminal objectives selected may be very different if the schools are in rural, well-to-do suburban, or city slum neighborhoods. And a superficial examination of the learning activity may make it seem that they are learning entirely different things.

Automation

A frequent reaction on the part of school personnel to any innovation is that it is just another aid to the teacher. I have read this statement (by different people) about programmed instruction, televisioin, and computer-assisted instruction. The system concept requires a change in this viewpoint.

The system concept requires an analysis of the functions required to accomplish a given objective, and the selection of the most efficient means to accomplish a given objective. Some means may be automated, others may require human action. So the teacher is viewed as a possible system component, in competition with other system components.

If the system view becomes widespread, people will play three different roles. One role is that of system designer. Then these systems will require managers. Finally, at the lowest level, will be the system component.

Since the teacher, when viewed as a system component, will be accomplishing specific functions, it seems clear there will be a requirement for a variety of sub-professional personnel in the system, rather than requiring everyone to be certified as a teacher.

Cost-effectiveness

Costs of such items as teacher salaries, textbooks, equipment, and school buildings must be determined to establish a school budget. Yet the effectiveness of these system components is seldom determined. An especial need exists to examine the costs imposed by the grade system in both school and college.

A CLOSING STATEMENT

When we compare the new concepts of the training technology (which, obviously, are not widely applied in training) with the present situation in education, it is clear there are some revolutionary ideas implied here. Among the major ones I have identified are:

1. The notion of requiring curriculum designers to accurately reflect the requirements of society.
2. The measurement of the effects of teaching, with the concurrent implication that effective principals and teachers will be appropriately rewarded, while non-teachers will be eliminated.
3. The abolition of 12 years of public school and four years of undergraduate college as entities, replacing them with the attainment of appropriate objectives as a basis for awarding diplomas. And there is the problem of developing a suitable role in society for the substantial numbers of students who are now capable of completing college by age 18 and under.
4. The notion of the human system component, which will be reflected in the teacher certification requirements.

It is clear there are more constraints in education than there are in training. Yet the concepts point the directions in which educational innovations should march.

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